

**Two New Species of *Spalangiopelta* from Oregon
(Hymenoptera: Chalcidoidea), with a
Discussion of Wing Length Variation**

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A major source of confusion in the higher classification of the Chalcidoidea is the composition of the family Pteromalidae. It is generally accepted that the Pteromalidae are not monophyletic, but rather a paraphyletic or polyphyletic assemblage. A high priority for a revised classification of the Chalcidoidea is to investigate the distribution of character states among and within monophyletic groups traditionally referred to the "Pteromalidae" as subfamilies. Comparative studies of these key taxa are necessary to provide a rational basis for the subdivision of the assemblage into monophyletic taxa.

In this paper we treat one such taxon, the Ceinae, a subfamily comprised of only two genera: *Cea* Walker, monotypic and previously recorded only from the Palearctic; and *Spalangiopelta* Masi, with 4 Palearctic and a single Nearctic species (see Graham, 1969 for key to Palearctic species and Yoshimoto, 1977). Diagnostic characters of Ceinae are: spiracles situated halfway between the front and hind margins of propodeum (Figs. 1, 2), antennal toruli separated from oral fossa by a distance less than diameter of torulus (Fig. 3), antennal formula 11353 (Figs. 3, 4, 5–10), and mandibles bidentate. *Spalangiopelta* is further characterized by an apomorphic configuration of the mesosoma: the hind margin of mesopleuron partly overlapping metapleuron (Fig. 1). Graham (1969), in his key to the subfamilies of Pteromalidae, stated that the malar sulcus is absent in Ceinae. However, a distinct malar sulcus is present in a new species of *Spalangiopelta* described herein (Fig. 3). This emphasizes the need for comprehensive descriptive work in evaluating the distribution of character states, which in turn is the basis for phylogenetic inference.

In this paper we summarize information demonstrating that the Ceinae is much more speciose and widespread in North America than previously realized. In particular, we 1) describe two new species of *Spalangiopelta*, both sympatric in western Oregon, 2) discuss variation in the development of wings in one of the new species, 3) summarize the data associated with undescribed species of *Spalangiopelta*, and 4) report for the first time the occurrence of *Cea* in the North America.

METHODS AND TERMS

Morphological terms follow Graham (1969) and Richards (1977) except 'prepectus' is used instead of 'postspiracular sclerite.' We refer to the transparent circular areas on the uncus of the forewing (Figs. 12, 18, 20) as 'sensilla,' following

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usage in the Eulophidae (e.g., Miller, 1970) and Mymaridae (e.g., Schauff, 1984). Sculpture and color are best viewed and are described under diffuse light. Sculpture patterns are difficult to discern with light microscopy in *Spalangiopecta* due to the small size of specimens (about 1 mm total length). Scanning electron micrographs were used both to describe and to illustrate surface sculpture; the terms for sculpture types follow Harris (1979). Measurements and their abbreviations are as follows: OOL, length of ocular-ocellar line; POL, postocellar line, distance between posterior ocelli; PN, length of pronotum along midline; MSC, length of mesoscutum along midline; and SC, length of scutellum along the midline. Length, width, and height, refer to the maximum value obtained by rotating the specimen so that both end points of the structure are in focus.

Type material will be deposited in the following collections: British Museum (Natural History), BMNH; California Academy of Sciences, CAS; Canadian National Collection, CNC; D. Christopher Darling, personal collection; currently housed at the Royal Ontario Museum, DCD/ROM; James A. DiGiulio, personal collection, JAD; Oregon State University Entomology Museum, OSU; United States National Museum, USNM; Paul E. Hanson, personal collection, PEH; and the University of California, Berkeley, UCB.

Specimens of *Spalangiopecta* were first encountered in the Systematic Entomology Collection at Oregon State University. This material was collected on January 26, 1971, by David Carlson, in McDonald State Forest, northwest of Corvallis (elevation about 150 meters). On the basis of Dr. Carlson's field notes, we were able to pinpoint both the precise habitat and the method of collection. The specimens were obtained by Berlese funnel extraction of the needle mat from the base of Douglas fir, *Pseudotsuga menziesii*, located at the interface between secondary growth forest and a meadow adjacent to Oak Creek.

A concerted effort was made during the winter of 1984–1985 to recollect this species and to document aspects of the life history. Litter samples were collected at 4 times during the winter and spring, and a total of approximately 50 cubic meters of litter was examined. Litter beneath different tree species was kept separate in some collections to assess possible habitat specificity. Only Douglas fir duff yielded specimens. Leaf-mining Diptera larvae were also individually reared in the winter of 1984; in Europe *Spalangiopecta alata* Bouček has been reared from a leaf mine of *Scaptomyza flaveola* Meigen (Diptera: Drosophilidae, cited in Bouček, 1961). However, no specimens of *Spalangiopecta* were obtained from this limited rearing program.

Considerable care has been taken to ensure that the species described herein as new are not previously described species with holarctic distributions. To date, we have been able to examine representatives of only two of the four Palearctic species (the holotype of *S. procera* Graham and a specimen of *S. alata* Bouček, determined by Bouček). Our contention that the Oregon material represents new species is based on these specimens and on descriptions and diagnoses in the European literature (Masi, 1922; Bouček, 1952, 1961; Erdős, 1955; Graham, 1966, 1969). Specific comparisons are presented for each species in the "Diagnosis" sections.

***Spalangiopecta felonia* Darling & Hanson, NEW SPECIES**

(Figs. 1–6, 11–16, 21, 23)

Type locality. — U.S.A. Oregon, Benton County, McDonald State Forest, 3 miles northwest of Corvallis.

Type material.—This species is described from 36 female specimens. The holotype was chosen from the largest single collection of this species ($n = 20$, collected Feb. 14, 1984) and is a fully-winged female with the following labels: “OR: Benton Co. 3 mi NW Corvallis McDonald Forest February 14 1985,” “D. C. Darling J. A. DiGiulio P. E. Hanson,” “Ex: needle litter *Pseudotsuga menziesii*,” “Holotype ♀ *Spalangiopecta felonia* D. C. Darling & P. E. Hanson 1985” [DCD/ROM]. Thirty-four female paratypes are designated from the type locality: January 17 1985, $n = 1$, D. C. Darling, P. E. Hanson, J. A. DiGiulio; January 26 1971, $n = 8$, D. Carlson; January 31 1985, $n = 4$, J. A. DiGiulio, P. E. Hanson; April 11 1985, $n = 2$, D. C. Darling. An additional female paratype is also designated: OR: Benton Co. 14 mi W Corvallis, Marys Peak, January 24 1985, G. L. Parsons and J. D. Oswald, Ex: moss, lichens and bryophytes [BMNH, CAS, CNC, DCD/ROM, JAD, OSU, PEH, USNM, UCB].

This species is known only from the type material and the hosts are unknown.

Derivation of specific epithet.—The specific epithet is an allusion to furtive and clandestine habits of this species.

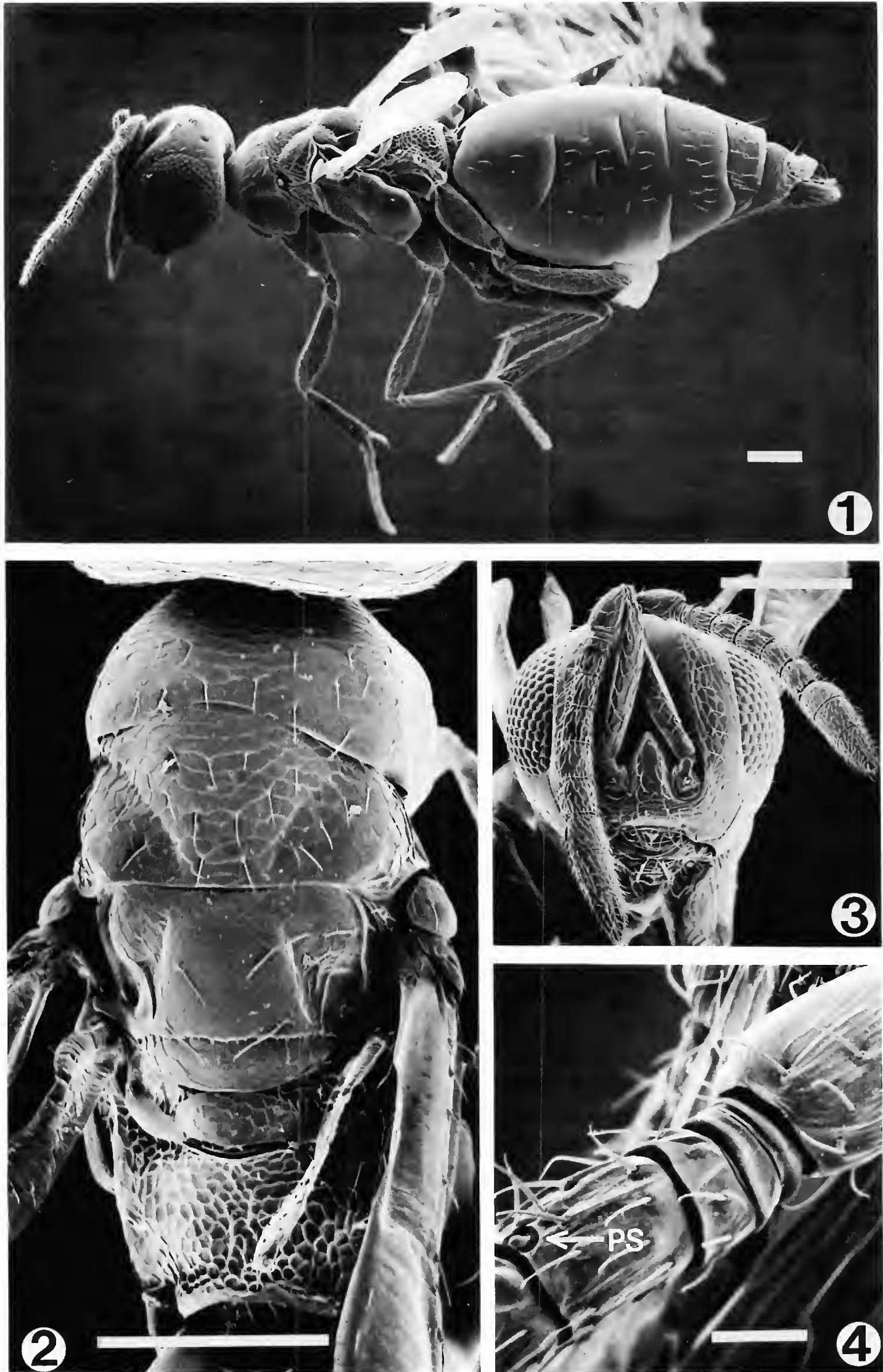
Diagnosis.—*S. felonia* females can be distinguished from the sympatric congener, *S. apotherisma*, by the more slender habitus (Fig. 21), the mesosoma narrower with respect to head width (cf. Fig. 22), the shorter ovipositor (Fig. 21; cf. Fig. 22), differences in forewing venation (Figs. 11–13, 15; cf. Figs. 17, 18) and the shape of the anelli and first funicular segments (Figs. 5, 6; cf. Figs. 7, 8). This species can be readily distinguished from *S. ciliata* Yoshimoto by the short, transverse petiole (Figs. 1, 2; cf. elongate, Yoshimoto, 1977, Fig. 1E, F), and the imbricate sculpture on the midlobe of the mesoscutum and scutellum (Fig. 2; cf. longitudinal microstriations, Yoshimoto, 1977, Fig. 1C, D).

Considering the Palearctic species, short-winged females of *S. felonia* most closely resemble *S. brachyptera* Masi. Only 1 out of 36 specimens of *S. felonia* have wings as short as *S. brachyptera* (reaching only to the level of the middle of the propodeum). Also, the coxae are darker in color in *S. felonia*. Long-winged *S. felonia* females would terminate as *S. alata* in Graham's key but can be distinguished by shorter funicular segments, lighter colored legs, more elongate thorax, and stigmal vein with a stouter, less linear uncus. The short ovipositor of *S. felonia* will serve to distinguish this species from the remaining Old World species (*S. dudichi* Erdős and *S. procera*) in which the ovipositor sheaths protrude markedly beyond the apex of the metasoma.

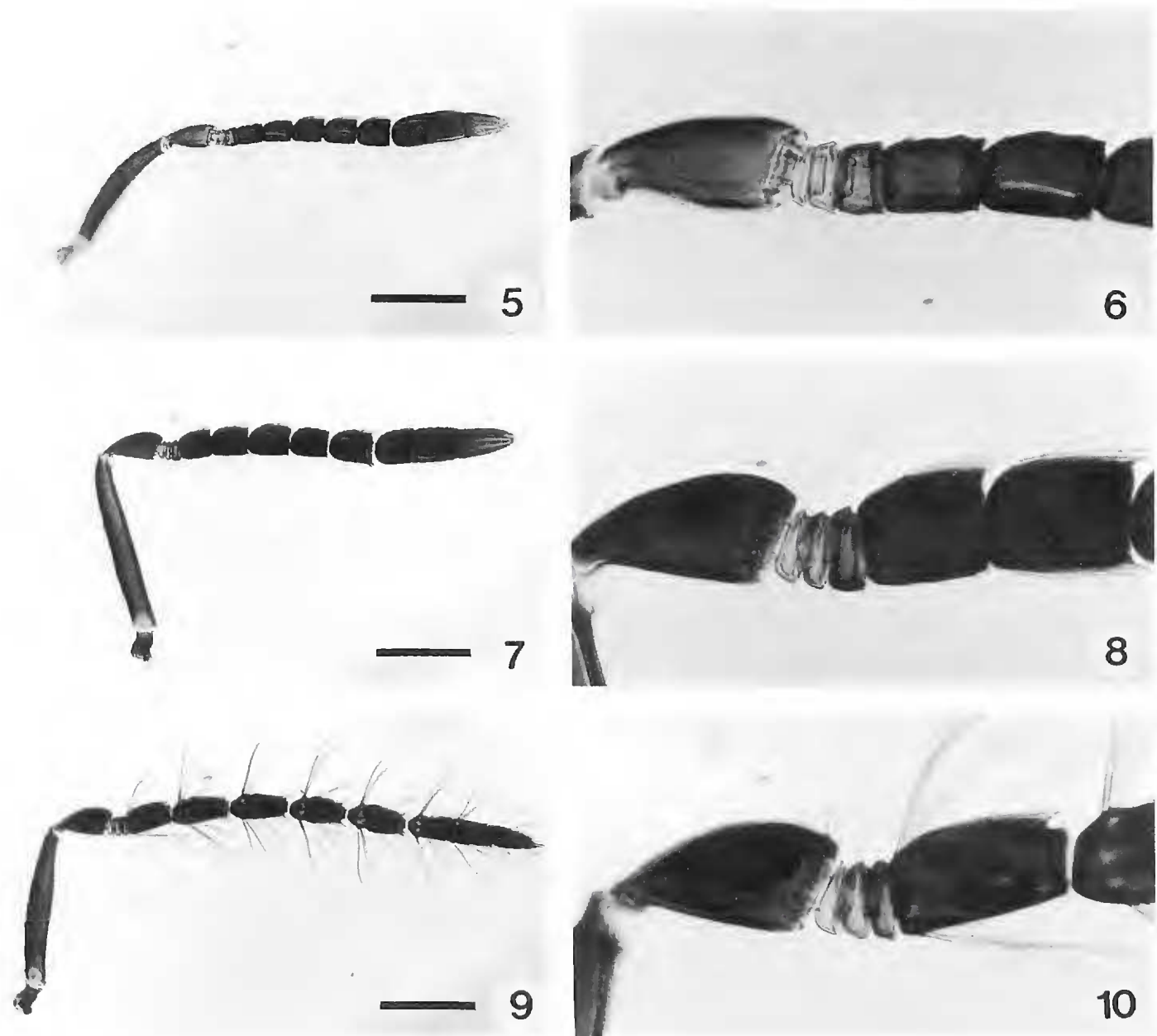
Description.—This description is based on both long-winged and short-winged females. Measurements are based on a total of 13 females, representing every collection locality and date and the full range of wing development. Description of wings and venation ratios are based on fully-winged specimens [$n = 5$]. Measurements and specific comments pertaining to the holotype are indicated by the notation [HT].

Female: Length, 0.9 mm to 1.4 mm [HT], slender in habitus. Head, mesosoma and metasoma black with faint metallic reflections, blue-green on mesosoma and blue-green to bronze on head; antenna and femora dark brown; tibiae and tarsi yellowish-brown. Forewing (Figs. 11, 12) weakly infumate, darker in region bounded by basal and stigmal veins.

Head (Fig. 3): In dorsal view, subquadrate (Fig. 21), width 1.4–1.8 [HT = 1.6] length; maximum width 0.9–1.2 [HT = 1.1] height; length of malar space 0.6 eye height; OOL less than POL, OOL/POL = 0.4 [HT]; head sculpture faintly im-

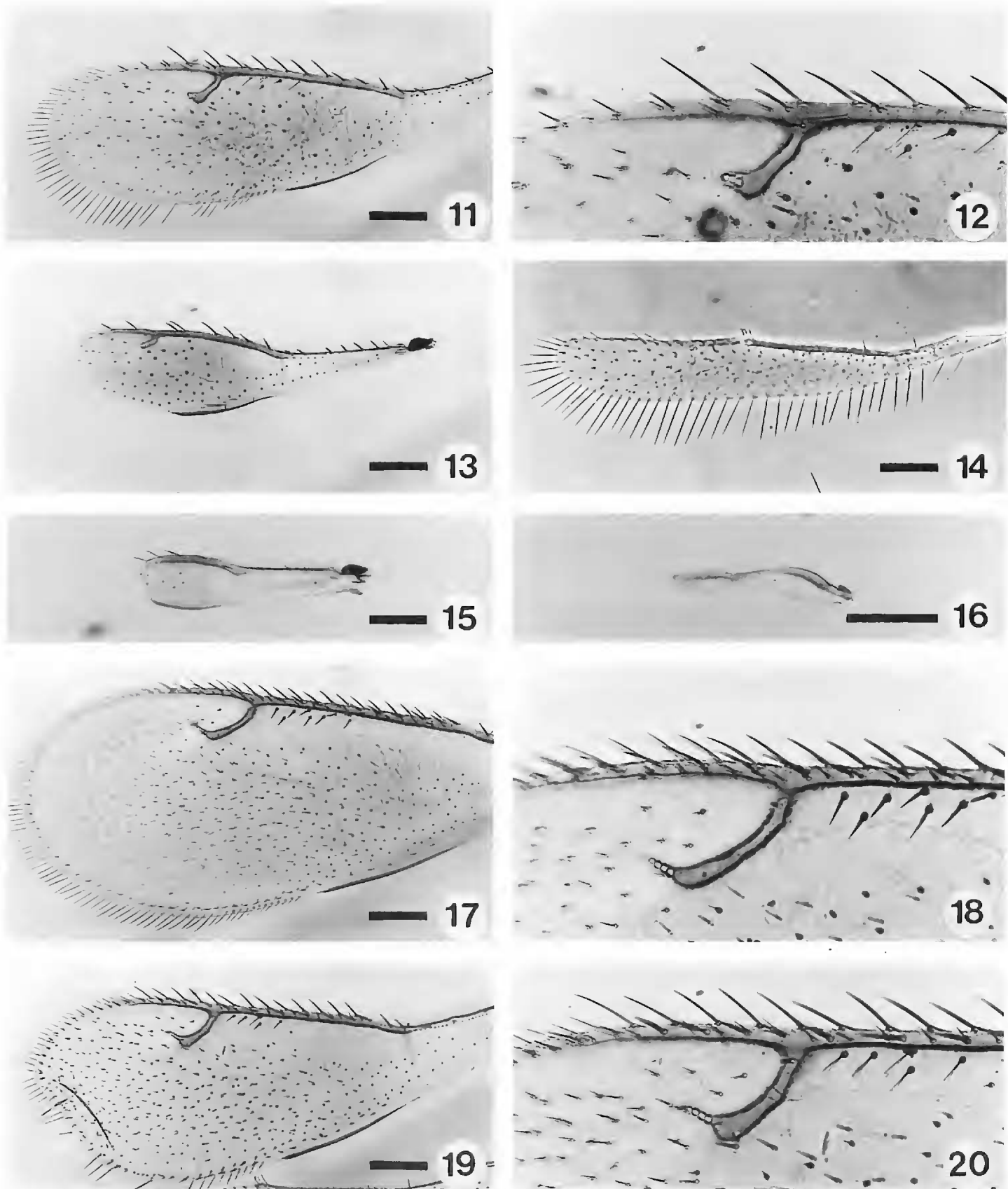


Figures 1-4. *Spalangiopelta felonia*, paratype female. 1. Lateral habitus. 2. Dorsal view of mesosoma. 3. Head, frontal view. 4. Detail of antenna, anelli and first funicular segment (left); PS, papilliform sensillum. Scale lines: Figures 1-3, 0.1 mm; Figure 4, 0.01 mm.



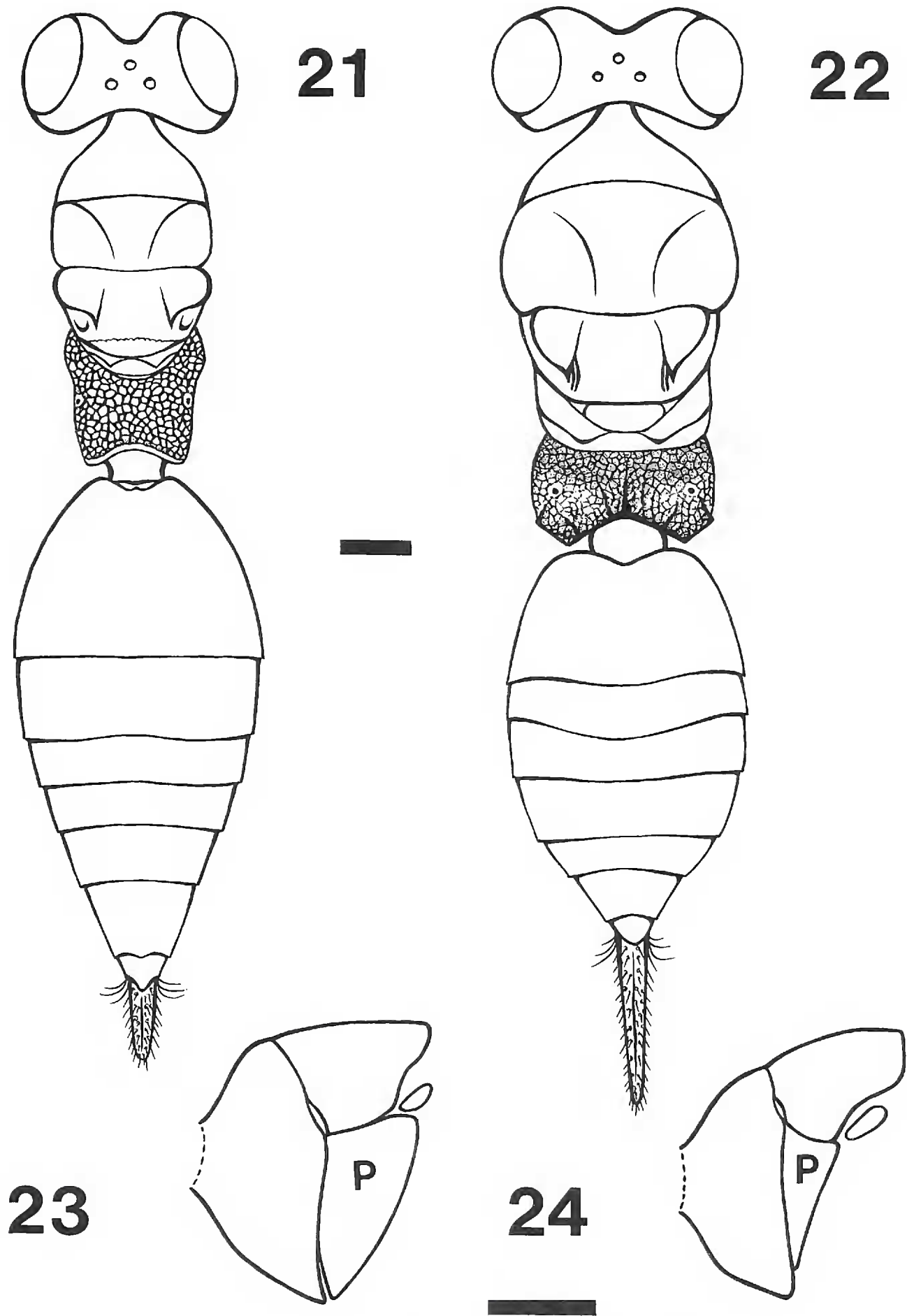
Figures 5–10. Antennae. 6, 8, 10. Detail of pedicel, anelli, and basal funicular segments. 5, 6. *S. felonia*, paratype female, DCD Slide #329. 7, 8. *S. apotherisma*, paratype female, DCD Slide #379. 9, 10. *S. apotherisma*, paratype male, DCD Slide #377. Scale lines 0.1 mm.

bricate; antennal scrobes deep, nitid, with high median callus; clypeus very reduced, anterior tentorial pits nearly touching oral fossa; gena with malar sulcus; eyes with minute hairs; occipital sulcus evident medially, about one-half distance between vertex and foramen. Antenna (Figs. 5, 6): scape with imbricate sculpture, length = 7 maximum width, slightly greater than eye height [HT, 20:19]; length of pedicel almost twice maximum width, longer than first funicular segment; anelli transverse and very small, combined length slightly less than first funicular segment, anelli 1 and 2 each 3 times as wide as long, anellus 3 more elongate, 2 times as wide as long, length subequal to anelli 1+2; first funicular segment elongate, subequal in width to anelli, remaining funicular segments wider and more quadrate; clava elongate, subequal in length to 4 preceding funicular segments, clava 2 and 3 each longer than last funicular segment, clava 3 conical; multiporus plate sensilla present on funicular segments 2–5, claval segments 2–3 and papilliform sensilla (Fig. 4) present distally on funicular segments 1–5 ($n = 2$). Mouthparts: maxillary palp 3-segmented; labial palp 2-segmented; labrum transverse, width greater than 3 times length along midline, distinctly emarginate with 5 long tapered marginal setae.



Figures 11–20. Wings. 12, 18, 20. Detail of stigmal region. 11–16. *S. felonia*. 11, 12. Forewing, long-winged paratype female, DCD Slide #353. 13. Forewing, paratype female with wings of intermediate length, DCD Slide #375. 14. Hindwing, long-winged paratype female, DCD Slide #353. 15. Forewing, short-winged paratype female, DCD Slide #359. 16. Hindwing, short-winged paratype female, DCD Slide #359. 17–20. *S. apotherisma*. 17, 18. Forewing, paratype female, DCD Slide #378. 19, 20. Forewing, paratype male, DCD Slide #376. Scale lines 0.1 mm.

Mesosoma: Slender, width 0.7–0.8 head width (Fig. 21), with imbricate sculpture except as noted; pronotum, mesoscutum, scutellum, and propodeum subequal in length, PN:MSC = 0.8–1.2 [HT], SC:MSC = 1.0–1.3 [HT]; dorsum depressed, metanotum and propodeum subhorizontal (Fig. 1); pronotum campanulate, wider than long, without a distinct collar; notauli present [HT] but less distinct in shorter-



Figures 21–24. Comparison of *S. felonia* (Figs. 21, 23) and *S. apotherisma* (Figs. 22, 24) paratype females. 21, 22. Dorsal habitus, sculpture illustrated only on propodeum. Note head shape relative to width of mesosoma, shape of mesosoma, and ovipositor length. 23, 24. Lateral view of mesosoma; P, prepectus. Scale lines 0.1 mm.

winged specimens; scutellum anterior to frenal groove almost smooth, apex broadly rounded, axillula with longitudinal costulae (Fig. 2); metanotum subequal in length to frenum, sculpture alveolate anterolaterad, indistinct on dorsellum, smooth posterolaterad (Fig. 2); propodeum distinctly alveolate, evenly convex, acarinate

and afoveate, smooth along posterior margin (Figs. 2, 21); prepectus broadly triangular (Fig. 23). Forewing (Figs. 11, 12): length of apical setae longer than length of stigmal vein, with strong setae on marginal and postmarginal veins and below marginal vein on under surface; marginal vein 3 times postmarginal, postmarginal vein 2 times stigmal; submarginal vein slightly shorter than marginal, stigma slightly enlarged, uncus short with 3 sensilla. Hindwing (Fig. 14): linear, with setae on apical and posterior margins subequal in length to width of hindwing.

Metasoma: Petiole 3 times as wide as long, with longitudinal costulae (Fig. 2); gaster smooth and shining with sparse white setae (Fig. 1); first tergite longer than following two combined; hypopygium reaching over half length of gaster; pygostyle not elongate, with 4 bristles (Fig. 1); ovipositor short, sheaths only slightly protruding beyond apex of metasoma (Figs. 1, 21), protruded distance one-third or less length of hind tibia.

Male: UNKNOWN.

Notes on wing length variation.—Figure 25 illustrates the relationship between the length of the forewing and body size, total length in millimeters. Wing length exhibits continuous variation and is not distributed as discrete morphs; the use of the terms brachypterous and macropterous should therefore be used with care. All small individuals have very short wings, but a range of wing lengths are found in larger specimens and almost the entire range of variation in wing length is found in specimens 1.2 mm in total length. Figures 11, 13, and 15 illustrate the forewings of long, intermediate and short-winged females. Wing reduction seems to proceed from the apex to the base of the wing and does not involve an overall reduction in the form of the wings, as evidenced by the vestiges of venation present in the shorter-winged forms. The submarginal vein is largely unaffected by the wing reduction and often accounts for the entire venation in short-winged individuals. The apical setae are completely absent in the shortened wings. The reduction in hind wings (Fig. 16; cf. Fig. 14) shows similar patterns, again with a marked reduction in the apical setae.

***Spalangioelta apotherisma* Darling & Hanson, NEW SPECIES**
(Figs. 7–10, 17–20, 22, 24)

Type locality.—U.S.A. Oregon, Benton County, McDonald State Forest, 3 miles northwest of Corvallis.

Type material.—This species is described from 3 female specimens and a single male. Two females were collected at the type locality April 14, 1985 by sweeping the understory vegetation around the bases of Douglas fir and a single female was collected in a pan trap in the vicinity of Ottawa, Canada. The male was also collected in Benton Co., Oregon, in a yellow pan trap. The holotype female bears the following labels: “OR: Benton Co. 3 mi NW Corvallis McDonald Forest,” “14 April 1985, D. Chris Darling,” “sweeping open Douglas fir forest,” “Holotype ♀ *Spalangioelta apotherisma* D. C. Darling & P. E. Hanson 1985” [DCD/ROM]. One paratype female has the same collection data as the holotype and an additional label: “Slide # 378—wings, 379 antenna, D. Chris Darling” [DCD/ROM]. The female paratype from Canada bears the following labels: “Ont; Nepean Slack Road Pan tr. 17–24.VI.1985 (sands) L. Masner” in addition to the paratype label [CNC]. The male paratype bears the following labels: “OR: Benton Co. 1984 5 mi WNW Corvallis IX,15–X,1 DC Darling” “slide # 376—wings, 377 antenna,

(one-half versus less than one-half eye height), and scape length (greater than versus equal to or less than eye height). In addition, *S. dudichi* is illustrated with elongate pygostyles (Erdős, 1955, Fig. 2, mislabelled) which are absent in *S. apotherisma*.

Description.—Measurements are based on the Oregon material and specific comments pertaining to the holotype are indicated by the notation [HT].

Female: Length, 1.3 [HT] to 1.6 mm. Head, mesosoma and metasoma dark brown to black with faint metallic bronze reflections; scape yellowish on anterior surface, tibiae and tarsi yellowish-brown. Forewing (Figs. 17, 18) infumate, forewing darker in region bounded by basal and stigmal veins.

Head: Transverse (Fig. 22), width 1.8 [HT]–1.9 length; maximum width = 1.2 height; length of malar space = 0.5 eye height; OOL = 0.7 POL. Head as in *S. felonia*, except malar sulcus evanescent. Antenna (Figs. 7, 8): as in *S. felonia*, except all three anelli more similar in size and shape, each about 3 times as wide as long; first funicular segment quadrate, similar in shape to distal funicular segments transverse; multiporus plate sensilla present on all funicular and claval segments, papilliform sensilla absent. Mouthparts not examined.

Mesosoma: Subequal in width to head (Fig. 22), 0.9 head width, pronotum more transverse than in *S. felonia*, PN:MSC = 0.6 [HT]–0.7, mesoscutum and scutellum equal in length, length of propodeum along midline about one half length of scutellum; dorsum of mesosoma arched in lateral view; mesoscutum sculpture imbricate, more distinct than in *S. felonia*, notauli present; scutellum, axillula, and metanotum as in *S. felonia*; propodeum alveolate, with longitudinal carinae and foveae posteriorly (Fig. 22), prepectus forming a narrow triangle (Fig. 24). Forewing (Figs. 17, 18): reaching apex of metasoma, 0.7 total body length, as in *S. felonia* except: length of marginal setae shorter than length of stigmal vein; postmarginal vein slightly shorter than 2 times stigmal vein; stigmal vein slender, and curved, stigma not enlarged, uncus elongate with 4 sensilla arranged in line at about 45 degree angle to postmarginal vein. Hindwing: setae on apical and posterior margins distinctly less than one-half width of hindwing.

Metasoma: As in *S. felonia* except: ovipositor long, sheaths protruding noticeably beyond apex (Fig. 22), protruded distance about one-half length of hind tibia.

Male: Length 1.4 mm. Color as in female. Sculpture and structure as in female except: head width twice head length, malar space 0.4 eye height, length of scape equal to eye height, only 6 times as long as broad. Antenna (Figs. 9, 10): funicular segments elongate, at least twice as long as wide, each with a basal whorl of setae; length of clava less than length of 3 preceding funicle segments, each also with a basal whorl of setae. Forewing (Figs. 19, 20) with stigma slightly enlarged. Mouthparts and genitalia not examined.

DISCUSSION

There are now seven described species of *Spalangiopecta* (4 Palearctic, 3 Nearctic) and these can be tentatively arranged in three groups. *Spalangiopecta ciliata* is quite distinct from the other species; unique characters of the females include the elongate petiole, the sculpture of mesoscutum, and the cupped forewings with very long setae. The remaining six species fall into two groups: with short ovipositors (*S. brachyptera*, *alata*, *felonia*) and those with long ovipositors (*S. dudichi*, *procera*, *apotherisma*).

Further studies will be necessary to test the naturalness of these groupings.

However, it is interesting to note that the only two species to display marked wing reduction (*S. brachyptera*, *felonia*) have short ovipositors, a character not obviously correlated with wing reduction. The only obvious character accompanying wing reduction in *S. brachyptera* and *felonia* is the reduction of the size of the mesonotum, most evident as the reduction of the thorax width relative to head width (Fig. 21). In brachypterous Hymenoptera, the mesonotum is the first external structure to become modified (Reid, 1941); further modifications involving the fusion of the thoracic segments have not occurred in short-winged Ceinae.

Many of the problems encountered in the systematics of Ceinae are the result of the rarity of specimens in collections which is probably due to a combination of factors: small size (about 1 mm), phenology (adults often collected in winter or early spring), and association with litter habitats. Collecting methods such as yellow pan traps, Malaise traps, and screen sweeping will often fail to collect species that frequent cryptic habitats, such as leaf litter, and therefore heat extraction techniques (Berlese or Tullgren funnels) should be added to the sampling arsenal.

The Ceinae remain very incompletely sampled in North America; recent museum visits have revealed additional undescribed species, each represented by 1 or 2 specimens. We refrain from describing these species until additional material is available for study but provide the label data and a brief summary to facilitate the collection of additional material.

Spalangiopelta appears to be widely distributed in California on the basis of material in the California Department of Food and Agriculture Collection: 2 short-winged females (Humboldt [sic] Co., 2 mi N Redway, III-1-72, T. R. Haig, berlese oak duff; Inyo Co., nr. Westgard Pass 7300' III-1975 ex Pinyon duff D. Giuliani, Coll.) and a short-winged male (Riverside Co. Whitewater Canyon, XII-27-1979, KW Cooper 79-127, berlese abandoned *Neotoma* nest at base of *Prosopis*). Note that these specimens were all collected during the winter and early spring in association with litter habitats. Specimens from Biosystematics Research Institute in Ottawa, Canada document the following: 1) there is an undescribed or perhaps holarctic species of *Spalangiopelta* that is sympatric with *S. ciliata* in the vicinity of Ottawa; 2) there is an additional undescribed or holarctic species of *Spalangiopelta* from Nova Scotia, Cape Breton National Park; and 3) *S. ciliata* occurs in Texas (San Jacinto Co., 5 km S Coldspring, Double Lk Cpgd, 22-24.V.83, M. Kaulbars). This is a considerable extension of the range; this species has only previously been recorded from central Canada. We also report here the first record of the genus *Cea* in North America based on two males provisionally identified as the European species *Cea pulicaris* Walker (Texas: Travis Co. Austin, Breckenridge Field Lab, 500' April 1984, J. A. DiGiulio, Yellow Pan Trap).

In addition to the new species and records of Nearctic Ceinae, this investigation has prompted many biological questions. *S. felonia* exhibits continuous variation in wing length and males have yet to be recorded in a rather large sample ($n = 36$), suggesting at least the possibility of thelytokous parthenogenesis. Its sympatric congener, *S. apotherisma*, is apparently fully winged and bisexual. These contrasts are amplified by the fact that the two species were collected in the same place, at the same time of the year, but by differing collecting techniques (Berlese funnels versus sweeping and pan trapping). Obviously additional biological information is needed, particularly the host association(s).

These results also serve to emphasize some of the complexities associated with the taxonomy of the Ceinae. Intraspecific variation in the development of wings is now known in both genera. The long-winged and short-winged forms of *Cea pulicaris* were originally described as separate species (Graham, 1969). This suggests that future descriptions of "brachypterous" species of *Spalangiopelta* be based on long series of specimens and made in comparison with fully winged forms. Also, the collection of this species exclusively through Berlese funnel sampling emphasizes the need to employ this technique more often and to search existing litter samples, not only for Ceinae but for litter-associated parasitic Hymenoptera in general. Although the description of *S. felonia*, and *S. apotherisma* should perhaps have awaited a more comprehensive revisionary treatment, we felt it was necessary to provide these descriptions and notes in order to stimulate interest and the accumulation of additional material; DCD is currently assembling material for a more extensive review of Nearctic Ceinae and would appreciate receiving additional specimens.

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